THE BIGAMIC GENERATIONS OF ANDRICUS CORRUPTRIX SCHLECHTENDAL AND ANDRICUS LIGNICOLUS HARTIG (HYMENOPTERA, CYNIPIDAE)

BY

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Leersum

Introductory

At the end of the last century BEIJERINCK (1897, p. 387 and 1902, p. 1) discovered that the bigamic generations of *Andricus* (= *Cynips*) *calicis* Burgsd. and *A. kollari* Htg. caused galls on *Quercus cerris*; thus he demonstrated for the first time heteroecism in case of gall-wasps. Although this discovery passed more or less into oblivion or was looked upon as rather doubtful, MARSDEN-JONES (1953, p. 195) proved beyond question that the circulans-gall on *Quercus cerris* contains the bigamic generation of *Andricus kollari*.[1])

BEIJERINCK knew only the two above-mentioned gall-wasps and for many years afterwards no other gall-wasps belonging to this group were known as occurring in the Netherlands. J. KOORNNEEF collected specimens of a new gall of this group in the surroundings of Velp in 1942; and from them he bred the wasp. It proved to be *Cynips* or *Adleria*, now called *Andricus lignicolus* Htg. Material of the same gall was sent to me in 1952; it had been collected by brother MAURENTIUS on Mount St. Pieter in Southern Limburg. In the same year I recieved this gall from Mr. W. C. VAN HEURN, who colleced it in Wilp near Deventer in the province of Guelderland. I myself found the gall on a tree of *Quercus robur*, which grew near a Turkisch oak in the neighbourhood of Leersum in 1954. Old specimens of *Quercus cerris* are also found at the country seat of Mr. VAN HEURN. The place near Velp where Mr. KOORNNEEF found the gall is known owing to the investigations of BEIJERINCK. There are many specimens of the Turkish oak in the neighbourhood there too.

The question remains whether the gall of *Andricus lignicolus* has been in the Netherlands for a long time, but was discovered at a later date, or whether this gall penetrated into this country in the course of this century. In my opinion the indications suggest that the latter is the case.

BEIJERINCK, an authority on the Dutch cynips and their galls, has examined thousands of kollari-galls in the course of his investigations, but he does not mention the lignicolus-gall. In some respects this gall resembles the kollari-gall, it is smaller, however, the surface is not smooth, but rather more irregularly grooved, and its colour is different. Furthermore the gall-chamber is situated differently from that of the other gall. We can hardly assume that this gall so clearly distinct from the kollari-gall would have escaped BEIJERINCK's attention if it had been present in Holland in his time. BEIJERINCK died in January 1931 and to the end of his life his interest in galls remained. The lignicolus-gall is not represented in the collection composed by BEIJERINCK and kept in the laboratory for Technical Botany at Delft, although this collection contains many specimens of the calicis- and kollari-galls.

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[1]) The species *calicis* and *kollari* and many others were formerly classed with the genus *Cynips*. ROHWER & FAGAN (1917, p. 357) classed the species *folii* with *Cynips* and changed the genus name of the above mentioned wasps into *Adleria*. Since it is known that the bigamic generations belong to *Andricus*, this name must also be used for *calicis* and *kollari* (see DOCTERS VAN LEEUWEN, 1955, p. 283).

The lignicolus-galls remain on the branches of the oak for quite a long time and they stand out most clearly on the bare twigs. I could not have failed to notice this gall, if it had been present for long.

HOUARD (1908, p. 235) mentions this gall as occurring in Europe and Asia Minor: RIEDEL (1910, p. 36) mentions for Germany that it has been found in Freiburg, Zwickau, Tharandt, Halle and Lobenstein; DALLA TORRE & KIEFFER (1910, p. 419) mention it for Germany, France, Italy, Sicily, Lower Austria, Hungary, Serbia, Bulgaria and Asia Minor. The places where the gall is found in Germany are situated in the south-eastern part of this country and for the rest the countries are all in southern Europe. It seems that we are justified in assuming that *Andricus lignicolus* is pressing steadily onwards from the south in a northernly direction. When the gall arrived in the Netherlands cannot be stated accurately, but it must have been in the course of this century as it was first found in 1942.

The gall of *Andricus corruptrix* is not quite so conspicuous as the former one, but still, it is clearly visible in winter on the bare twigs of *Quercus robur* and would not have easily escaped the attention of an experienced gall-explorer. I collected the gall for the first time at the country-seat of Mr VAN HEURN near Wilp in 1954 and afterwards also in Leersum; in both cases in the immediate neighbourhood of *cerris* oaks. It may be that it was not detected until it was present in great numbers. But even so it seems that we are justified in assuming that the gall made its appearance in the Netherlands in the course of this century.

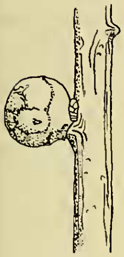
HOUARD (1908, p. 216) mentions the gall as occurring in central Europe (Germany), Italy, Serbia, and Asia Minor; RIEDEL (1910, p. 36) mentions it for Freiburg, Tharandt, and Dresden; DALLA TORRE & KIEFFER (1910, p. 422) mention the gall as collected in Germany (Freiburg), Hungary, Serbia, Italy, North Africa (Cabilia), and Asia Minor, consequently this too is a cynips which is progressing from southern regions in a northern direction.

Andricus kollari, found in the Netherlands for the first time in the middle of last century (see DOCTERS VAN LEEUWEN, 1955, p. 279) and thus belonging to the Dutch fauna for over a hundred years is strongly infected by parasites. RIEDEL (1910, p. 37) mentions the names of 10 wasps parasitizing on this gall-wasp. Also the galls are strongly infected by inquilines, four wasps of which are mentioned by RIEDEL. When breeding wasps from the kollari-galls one finds that many of them lodge parasites and inquilines.

When breeding the lignicolus and corruptrix-wasps I obtained only the rightful inhabitants and not a single parasite or inquiline. Riedel (1910, p. 36) mentions no less than five wasps as parasites of *lignicolus* and besides seven inquilines infecting the galls. Mayr ((1870, p. 16) calls the lignicolus-gall one of the most common galls of Austria and Hungary. This demonstrates that the wasps have come to Holland, but the parasites and inquilines have not yet managed to settle in this country. This too may be looked upon as support for my opinion that the arrival in Holland of *Andricus lignicolus* and *A. corruptrix* took place at a recent date.

Andricus lignicolus Hartig

The gall inhabited by this gall-wasp, just like the one of *Andricus kollari* does not develop from the bud, but by the side of it on annual twigs; the bud is slightly pushed aside, see figure 1; it is rarely found by the side of the terminal bud. This gall is much smaller than the kollari-gall; it is from 5 to 8 mm in diameter. The surface is rusty-brown to yellowish-brown and often covered by an irregular white layer. This layer is interrupted by cracks in the epidermis, thus forming a kind of reticulate marking which is sometimes scarcely developed. At any rate the surface of this gall is not smooth as that of the kollari-gall. The clearest difference is the situation of the larval chamber. The kollari-gall has a central gall-chamber; the lignicolus-gall has its chamber situated near the attachment; the exit-hole too is situated there, see figure 2.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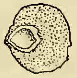
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Fig. 1. Gall of *Andricus lignicolus* Htg., nat. size
Fig. 2. Median section of this gall, larval chamber basal, nat. size.

Late in the summer the gall is ripe and its colour gets darker; it remains attached to the branch for a long time and therefore it can easily be detected in winter. In the course of the second year the wasps emerge from the galls. Mayr (1870, p. 17) and Riedel (1910, p. 36) found the wasps emerged during May and June. The wasps of the galls collected near Wilp emerged between the 11th and the 18th of July.

Andricus corruptrix Schlechtendal

The galls inhabited by this gall-wasps are rather varied and therefore they are not easily described. This gall arises by the side of an axillary bud, less often a terminal bud, on short annual twigs, preferably on those that do not show a strong longitudinal growth, such as twigs arising from cryptoblasts on the trunks of old oak-trees. This gall is also found on younger oaks. Under the bud the twig is rounded to cylindrically swollen; on the free end there develop from one to three short, rounded, obtuse excrescences, which may be one to two mm long. Sometimes they slightly diverge. In the middle of these excrescences or where only one has developed by its side, is a small, flat, dark, pubescent wart. The surface of the gall is glabrous and shining, its colour reddish-brown. Within there is a spacious larval chamber with a thin, but hard wall. The cavity is completely

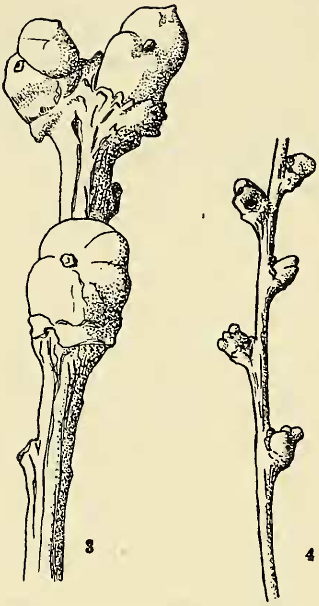

Fig. 3. Three galls of *Andricus corruptrix* Schlchtd. × 3. Fig. 4. Five galls of *Andricus corruptrix* Schlchtd., nat. size.

taken up by the full-grown gall-wasp larva. The whole gall is from four to five mm long and four mm across, see figure 3 and 4.

MAYR (1870, p. 22) and RIEDEL (1910, p. 36) state that the wasps emerge in May of the second year. In Leersum the gall-wasps came out from the galls between August 5 and 10.

Experiments with the gall-causers

The kollari, lignicolus and corruptrix-wasps are robust, glossy brown insects with long wings, which protrude behind the abdomen. Consequently they can fly extremely well. RIEDEL (1910, p. 36 and 37) writes that these three wasps are not distinguishable one from another. DALLA TORRE & KIEFFER (1910, p. 419, 420 and 422) describe the wasps extensively. It is a fact that the description of the kollari-wasp is completely similar to that of the lignicolus-wasps. The corruptrix-wasp is described most extensively and the description also contains characteristics which are not mentioned for the other two wasps, so that here a comparison is not possible. The difference between the three wasps is mainly the time at which they emerge from the galls and the size of the insects. According to DALLA TORRE & KIEFFER the kollari-wasp is from 4.8 tot 6 mm long, the lignicolus-wasp from 4 to 5.4 mm and the corruptrix-wasp from 3.3 to 4 mm. The distinction is clear when a great number of wasps is put next to one another during examination, but can hardly be observed in nature. It seems probable that a thorough examination by a specialist will bring to light morphological differences of the wasps. I do not consider myself competent in this matter.

Twigs of *Quercus robur* were put in a large glass-jar and some living specimens of the corruptrix-wasp were let lose inside. The insects ignored the twigs and walked up and down against the wall of the bottle. Occasionally they landed on a twig, but were not in the least interested. As soon as I put some twigs of the Turkish oak in the bottle their behaviour changed completely; they walked along the twigs with trembling antennae and visited one bud after another. Within half an hour I noticed how one of the wasps settled on a bud, its head turned towards the end of the twig. Soon the thin ovipositor appeared boring its way into the bud. The same thing happened in case of the lignicolus-wasps; they became quiet as soon as the cerris-twigs were inserted with them and immediately began to lay eggs. It is a common phenomenon that wasps of the agamic generation quickly and easily proceed to laying eggs.

This showed clearly that the second generation, the bigamic one, would occupy a gall on *Quercus cerris*. But which gall ? Only two galls are known as occurring on this oak in the Netherlands, the circulans-gall in the buds contains the bigamic generation of *Andricus kollari*; the other, the cerris-gall in the stamens that of *Andricus calicis*. Therefore I was very curious to know the galls containing the bigamic generations of *Andricus corruptrix* and *A. lignicolus*. The literature describes many galls occurring on the Turkish oak, containing bigamic generations. I supposed that some of them occurred in the Netherlands. An examination, however, proved something different.

In my garden grows a Turkish oak, some twenty years old, which does not yet flower. In my garden are corruptrix-galls but no lignicolus-galls; the latter were found in the vicinity of the old, flowering trees in the country-seat of Mr. van Heurn near Wilp. Therefore there was a possibility that the bigamic generations of *lignicolus* would develop from galls on the stamens. I also found lignicolus-galls in the estate of Broekhuizen near Leersum, where an old, flowering tree of *Quercus cerris* grows.

We made experiments in my garden as well as in Mr. van Heurn's garden. I am very grateful to Mr. van Heurn for his help and interest in my work.

In my garden several cerris twigs were sleeved with large bags of gauze, and several lignicolus-wasps were let loose; the same thing happened on other twigs with corruptrix-wasps. We sleeved branches of the old trees at Wilp which we might safely assume to flower next spring and let wasps of *lignicolus* loose inside.

In order to prevent other wasps attacking the branches, we left the sleeves round the branches for three months. This turned out to be wrong; the leaves dropped and the branches died partly or even completely. Particularly in my own garden the breeding experiment failed to yield any success. At Wilp the damage of the long period of sleeving the branches was less serious, yet the result was not good. On one of the twigs I detected a small gall, not yet collected on *Quercus cerris*. But I found hundreds of this new gall on branches of the Turkish oak which had not previously been sleeved, at Wilp as well as in my garden in Leersum.

Description of the new gall

The new gall is situated mostly alone, rarely with two specimens in a bud, its base hidden between the bud-scales and only the upper half projecting. The gall is from

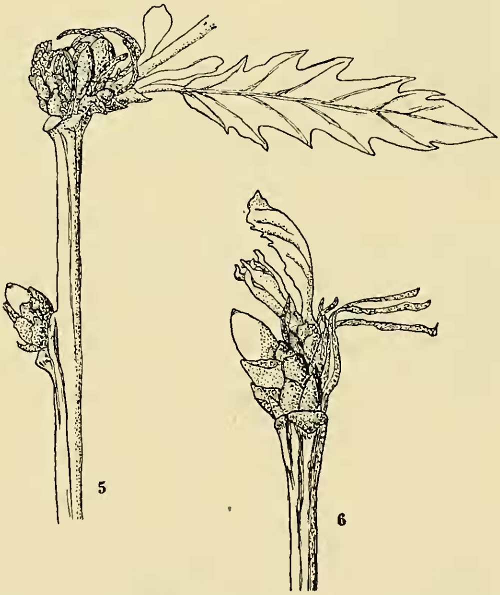

Fig. 5. Gall of *Andricus* species, × 3. Fig. 6. The same gall. × 3.

2 to 7 mm high and about one mm across. The wall is very thin, its colour pale greyish-brown, the surface is more or less velvety-glossy. (The surface is not granulate, which it is in case of the circulans-galls; besides the circulans-galls are mostly situated in a bud in clusters of from five to eight galls). The top of the new gall tapers to an obtuse, somewhat arching end; the top shows often a tiny black spot, see figure 5 and 6. The exit-hole arises on one side near the top of the gall.

As soon as Mr. VAN HEURN informed me that the cerris-oaks began to come out, I went to Wilp, but I came slightly late, for the new galls become visible before the leaves. Besides the wasps emerge immediately. Consequently I found many galls, but only few of them were still closed. At Leersum too it turned out that I was too late. At Wilp as well as at Leersum I collected some closed galls; the same day four wasps emerged, two of which from the Wilp material, the other two from the Leersum galls. There were three ♀ and one ♂ wasp.

They are small black wasps, which I cannot discern from those of *Andricus circulans*. The wasps emerged on May 9th and 10th, 1954. Thus the new gall contains the bigamic generation of *Andricus corruptrix* or that of *Andricus lignicolus*. It may also be that the galls of both wasps are similar.

CONCLUSIONS

This first examination has taught us, that the agamic lignicolus and corruptrix-wasps lay eggs in the leaf-buds of *Quercus cerris* and that very small galls arise from them. The examination is not yet finished; we still have to demonstrate that the wasps of this new gall go to the buds of *Quercus robur* after copulation, in order to deposit the eggs there and that corruptrix and lignocolus-galls arise from these galls.

Such experiments take a long time; it may be years before a complete result has been obtained. Although planning to proceed with my investigations, I thought it peferable at my age, to publish the results obtained in 1955 now.

Miss J. M. MAASLAND was so kind as to make the drawings reproduced in this article. For her help and interest in my work I tender her my hearty thanks.

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